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CLAIMS

1. A method for forming at least one opening in an organic-containing insulating layer, comprising the steps of:

covering said organic-containing insulating layer with a bilayer, said bilayer comprising a resist hard mask layer, being formed on said organic-containing insulating layer, and a resist layer being formed on said resist hard mask layer,

patterning said bilayer,

creating said opening by plasma etching said insulating layer in a reaction chamber containing a gaseous mixture, said gaseous mixture comprising a fluorine-containing gas, an inert gas and essentially not an oxygen-containing gas; and

controlling said plasma etching, while creating said opening, in a manner that substantially no etch residues are deposited and that the side walls of said opening are fluorinated during said plasma etching to thereby enhance the anisotropy of said plasma etching.

2. A method as recited in claim 1, wherein said organic-containing insulating layer comprises at least one unsaturated carbon bond.

3. A method as recited in claim 2, wherein said organic-containing insulating layer is selected from a group comprising the benzocyclobutarenes, poly arylene ether, aromatic hydrocarbon and polyamides.

4. A method as recited in claim 1, wherein

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said resist hard mask layer is a silicon oxide, or a silicon nitride, or a silicon oxynitride, or a silicon carbide, or a silicon oxycarbide layer.

5. A method as recited in claim 1, wherein said inert gas is nitrogen and wherein the ratio of the amount of nitrogen in said gaseous mixture to the amount of fluorine containing gas in said gaseous mixture is larger than 2:1.

6. A method as recited in claim 1, wherein said fluorine-containing gas is SF_6, or NF_3, or C_2F_6, or CF_4 or CHF_3 or CH_3F or CH_2F_2 or mixtures thereof.

7. A method as recited in claim 1, wherein said opening is at least one via hole, said via hole extending through said insulating layer to an underlying conductive layer or an underlying barrier layer.

8. A method as recited in claim 1, wherein said gaseous mixture further comprises an oxygen containing gas.

9. A method for forming at least one opening in an organic-containing insulating layer comprising the step of:

covering said organic-containing insulating layer with a bilayer, said bilayer comprising a resist hard mask layer, being formed on said organic-containing insulating layer, and a resist layer being formed on said resist hard mask layer,

patterning said bilayer,

creating said opening by plasma etching said organic-containing insulating layer in a reaction chamber containing a gaseous mixture, said gaseous mixture comprising an oxygen-containing gas and an inert gas, said inert gas and said oxygen-containing gas being present in said gaseous mixture at a predetermined ratio, said ratio being chosen such that spontaneous etching is substantially

avoided.

10. A method as recited in claim 9, wherein said organic-containing insulating layer is a low K organic polymer layer.

11. A method as recited in claim 9, wherein said resist layer is selectively removed from said hard mask layer while creating said opening.

12. A method as recited in claim 9, wherein said oxygen-containing gas in said gaseous mixture is O_2 and said inert gas in said gaseous mixture is nitrogen.

13. A method as recited in claim 12, wherein said ratio of nitrogen in said gaseous mixture to oxygen in said gaseous mixture is in the range from 5:1 to 2:1.

14. A method as recited in claim 10, wherein prior to plasma etching in said reaction chamber containing said gaseous mixture, a first part of said opening is created by plasma etching said insulating layer in said reaction chamber containing a first gaseous mixture, said first gaseous mixture comprising a fluorine-containing gas and an inert gas;

controlling said plasma etching in said reaction chamber containing said first gaseous mixture, while creating said first part of said opening, in a manner that substantially no etch residues are deposited and that the side walls of said first part of said opening are fluorinated during said plasma etching to thereby enhance the anisotropy of said plasma etching in said reaction chamber containing said first gaseous mixture.

15. A method as recited in claim 14, wherein said opening has positively sloped side walls.

16. A method for forming at least one opening in an organic-containing insulating layer, comprising the steps of:

covering said organic-containing insulating

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layer with a bilayer, said bilayer comprising a resist hard mask layer, being formed on said organic-containing insulating layer, and a resist layer being formed on said resist hard mask layer,

patterning said bilayer,

creating said first part in said opening by plasma etching said insulating layer in a reaction chamber containing a gaseous mixture, said gaseous mixture comprising a fluorine-containing gas, an inert gas and essentially not an oxygen-containing gas; and

controlling said plasma etching, while creating said first part in said opening, in a manner that the side walls of said first part of said opening are fluorinated during said plasma etching to thereby enhance the anisotropy of said plasma etching.

creating said second part in said opening by plasma etching said organic-containing insulating layer in a reaction chamber containing a gaseous mixture, said gaseous mixture comprising an oxygen-containing gas and an inert gas, said inert gas and said oxygen-containing gas being present in said gaseous mixture at a predetermined ratio, said ratio being chosen such that spontaneous etching is substantially avoided and being chosen such that said opening is completely formed whereby said resist layer is removed.